

**United States Naval Academy
Mechanical Engineering Department**

EM468 Nuclear Energy Conversion

Catalog Description: EM468 Nuclear Energy Conversion

Credit: 3 (3-0-3)

Principles of the conversion of nuclear energy into useful power are covered. Various types of nuclear power plants, their design, cycles, load following characteristics, etc., are studied. Advanced nuclear energy systems, including fusion, and direct nuclear energy conversion systems are also studied.

Prerequisites: Reactor Physics I

Corequisites: none

Textbooks: M.M. El-Wakil, *Nuclear Energy Conversion*, American Nuclear Society, 1982.

Course Director: Professor Harper

Objectives¹:

1. To give the student an understanding of the various types of nuclear fuel energy conversion systems, including an analysis of their neutronics, thermodynamics, and heat transfer characteristics. (a, b, c, d)

Course Content:

| No. | Topic or Subtopic | hrs. |
|-----|---|------|
| 1 | Nuclear Reaction Rates | 6 |
| 2 | Reactor Heat Transfers | 10 |
| 3 | Thermodynamics of reactor power systems | 4 |
| 4 | Boiling Water Reactors | 4 |
| 5 | Pressurized Water Reactors | 4 |
| 6 | Gas Cooled Reactors | 4 |
| 7 | Breeder Reactor Systems | 4 |
| 8 | Isotopic Heat Sources | 3 |
| 9 | Direct Energy Conversion systems | 3 |
| 10 | Fusion Power Systems | 2 |

Evaluation:

1. Quizzes
2. Homeworks
3. Term Paper
4. Exams
5. Oral Presentations

Acquired Abilities²:

- 1.1 Students will demonstrate the ability to evaluate nuclear reaction rates, taking into account neutron flux distribution due to geometry and materials (1,2,4)
- 1.2 Students will demonstrate the ability to evaluate reactor heat rates for different fuel geometries, including the calculations of key temperatures (1,2,4)
- 1.3 Students will demonstrate the ability to apply general thermodynamic concepts to nuclear power plant systems, including Carnot cycle limitations (1,2,4)
- 1.4 Students will demonstrate the ability to perform detailed thermodynamic analyses on the following nuclear power systems: boiling water reactors, pressurized water reactors, gas cooled reactors, and breeder reactors (1,2,4)
- 1.5 Students will demonstrate the ability to evaluate nuclear isotopic heat sources that are used in direct energy conversion systems (1,2,4)
- 1.6 Students will demonstrate the ability to understand the basic concepts of future nuclear energy systems, including fusion and other novel systems (1,2,3,4,5)

Date of Latest Revision: 6 November 2001

¹ Letters in parenthesis refer to the [Program Objectives](#) of the [Mechanical Engineering Program](#).

² Numbers in parenthesis refer to the evaluation methods used to assess student performance.